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PARADIGMATIC CHANGE OF CENTRAL BANKING - MEASURING THE ANNOUNCEMENT EFFECT OF ECB'S ASSET PURCHASE PROGRAMMES

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UNIVERSITY OF OULU ABSTRACT OF THE MASTER'S THESIS

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Abstract

When the interest rates were approaching zero in the aftermath of the global financial crisis of 2008, the major central banks of the global economy adopted the use of so-called unconventional monetary policies. Of the unconventional monetary policy tools, the large-scale asset purchase programmes, also called balance sheet policies, are the most prominent one and their popularity has not declined, on the contrary. The monetary responses of the European Central Bank (ECB) and the Federal Reserve (Fed) to the latest global crisis, the Covid-19 pandemic, confirmed this as balance sheet policies were introduced once again.

The global financial crisis is seen as the turning point for monetary policy for especially the major central banks such as the ECB and the Fed. For this reason, the causes behind the crisis and subsequent ramifications are discussed in this thesis. The transition from conventional monetary policies to unconventional policies is shown and the monetary transmission mechanism, through which the monetary decisions affect the economy and asset prices, is explained.

Furthermore, this thesis measures the announcement effect of ECB's asset purchase programmes on two major stock indices: STOXX Europe 600 and S&P 500. The announcement effect is tested with event study methodology. In order to silence the unwanted noise from other macroeconomic news that might compromise the results, a relatively short estimation period of 30 days is chosen for the event study and is placed right before the event window. Abnormal returns are then calculated over the three-day event window of [-1,1]. The results show that the announcement effect of ECB's asset purchase programmes is significant and yields positive cumulative abnormal returns on both STOXX Europe 600 and S&P 500 indices over the three-day event window.

Finally, through discussion, this thesis argues that we are witnessing a paradigmatic change in central banking as policies once classified as unconventional have been used over the conventional ones' ever since the financial crisis. This is especially true with the ECB as it has kept the key interest rates of the euro area close to zero for years and no change is visible on the horizon.

Keywords
Abnormal returns, announcement effect, European Central Bank, unconventional monetary policy

Additional information

CONTENTS

APPENDICES

FIGURES

TABLES

1 INTRODUCTION

The financial crisis of 2008 can be seen as a turning point for monetary policy, when major central banks were forced to change the means of monetary policy as the so-called conventional monetary tools were insufficient to respond to the shock and subsequent economic recession caused by the crisis. This is especially true with the European Central Bank (ECB) and the Federal Reserve (Fed) of the U.S., as these central banks decreased their key interest rates to a point, where the zero bound of interest rate was reached. The zero bound of interest rate is a macroeconomic problem after which no further interest rate cuts are possible without the rate becoming negative. Indeed, when the interest rates approach zero, the tools of conventional monetary policy are not effective anymore. In such an environment the use of unconventional monetary tools, large-scale asset purchases in particular, is the most effective way to conduct monetary policy.

The purpose of this thesis is to evaluate how the means of monetary policy have changed after the financial crisis and what repercussions have followed since. Furthermore, the short-term effect of ECB's asset purchase programmes on stock markets is examined to see whether the channels of unconventional monetary policy transmission mechanism work under the assumptions of the efficient market hypothesis. Stock prices are a good way to test the efficient market hypothesis and the effectiveness of monetary transmission channels, as they are highly sensitive to any changes in the economic conditions. In addition, the international integration and co-movement of stock markets is studied by comparing the effects on the European stock market (STOXX Europe 600 index) and on the U.S. market (S&P 500 index).

The research questions are as follows:

1) Have the so-called unconventional monetary tools displaced more conventional ones in the ECB monetary policy toolkit?
2) Do ECB's asset purchase programme announcements have a statistically significant announcement effect for STOXX Europe 600 and S&P 500?
3) If an announcement effect is found, are the short-term abnormal returns positive or negative?

4) Do the STOXX Europe 600 and S&P 500 respond to these announcements similarly?
5) Which hypotheses could explain results?

To answer the first research question, the monetary policy of ECB and possible limitations of it are discussed throughout the thesis. To answer other research questions, quantitative research is conducted using the event study methodology. The event study is a commonly applied method to measure the impact of a specific event on stock prices. The event study is applied to determine, whether abnormal returns occur around the events, which are the dates, when the ECB has introduced its asset purchase programmes to the public. Abnormal return is the difference between the actual asset return and the predicted asset return.

The rest of the thesis is structured as follows: Following subchapter 1.1 presents the previous studies concerning the announcement effect of large-scale asset purchase programmes to stock markets. Chapter two deals with the financial crisis and crises that have followed since. This chapter creates an important introduction to why the means and tools of central banking have gone through a paradigmatic change in a relatively short time period. Furthermore, the aftermath of the financial crisis is briefly discussed. Chapter three assembles both the conventional and the unconventional tools of central banks and compares the post financial crisis usage of them between the ECB and the Fed. The monetary transmission mechanism of unconventional monetary policies is described in chapter four. Furthermore, this chapter presents the link between monetary policy and stock prices and presents the existing assumptions of efficient markets and the co-movement of international stock markets. Chapter five describes the event study methodology and gives description of the data used in the event study of this thesis. The results from the event study are presented and discussed in chapter six. Chapter seven concludes the thesis and sets out the expected direction of monetary policy based on the findings of this thesis.

1.1 Previous studies

Existing literature suggests that large-scale asset purchase programmes tend to have a greater impact on asset prices in periods of high financial stress. However, Altavilla et al. (2015) provide support for the view that the effects of asset purchases are not limited to times of financial market stress, but more on the strength of monetary transmission mechanism through channels of transmission. As long as the channels of transmission are strong, we can compare purchase programmes that have occurred at different times under different market conditions.

Fratzscher et al. (2014) study the short-term impact of the ECB's unconventional monetary policy measures on the asset prices in the euro area and globally. They also test the transmission mechanism of monetary policy through a number of transmission channels including the portfolio balance channel. Using daily data over the period of May 2007 to September 2012, they find that both the announcement and subsequent operations of Securities Market Programme (SMP) and Outright Monetary Transactions (OMT) create positive spillovers to global equity markets. However, as Fratzscher et al. compare their results against the previous results from the U.S. markets, they conclude that the positive spillovers from ECB's policies are more limited than the ones from Fed's policies, suggesting that the U.S. plays a more prominent role in the global financial cycle than Europe.

Using an event study method, Haitsma et al. (2016) examine the stock market reaction to ECB's policy announcements between 1999-2015. Their results suggest that especially unconventional monetary policy surprises affect the Euro Stoxx 50 index and that the price reaction is largest among the past loser stocks. Furthermore, Haitsma et al. show that the value stocks are affected more by the unconventional monetary policy announcements than growth stocks. Kontonikas and Kostakis (2013) receive similar results from the U.S. market.

Georgiadis and Gräb (2016) study the announcement effect of ECB's Asset Purchase Programme (APP) on global equity prices. The APP is the ECB's first QE programme and the announcement was given on 22 January 2015, when the ECB announced that it will engage in monthly purchases of €60 billion worth of sovereign bonds until at

least September 2016. Georgiadis and Gräb find that the APP announcement boosted equity prices around the world by supporting investor confidence and reducing the risk of deflation and persistent stagnation in the euro area. They find that the APP led to a significant abnormal return of 3.94% on advanced economies and to a significant abnormal return of 4.13% on emerging markets Furthermore, Georgiadis and Gräb find evidence that, as the message of the APP was so strong, investors rebalanced their portfolios by reducing the weight on emerging markets and increasing the weight on advanced economies' financial markets. As such, the cumulative response of advanced economies increased to almost 11%.

However, the relationship between monetary policy and stock prices is not so unambiguous that expansionary monetary announcements (i.e., lowering short-term interest rates, conducting asset purchases) would necessarily lead to a positive stock market reaction and that contractionary monetary announcements (i.e., increasing short-term interest rates, reducing asset purchases) would necessarily lead to a negative stock market reaction. Kerssenfischer (2019) argues that while the ECB's surprise announcements have strong effects on bond yields and exchange rates, the impact on stock prices and other economic expectations is puzzlingly small and often controversial. Using high frequency futures data to isolate market reactions to ECB's monetary policy announcements, Kerssenfischer shows that after a supposedly contractionary shock (i.e., rising interest rate) unemployment falls, growth and inflation expectations rise and also stock prices frequently rise rather than drop. Kerssenfischer justifies these results by stating that, rather than just changing market participants' expectations on current and future path of monetary policy, these announcements also reveal the central bank's economic outlook. As such, if a central bank reveals favourable information about the economic outlook while rising interest rates (or reducing the quantity of asset purchases), stock prices should rise as the main message would be that the economic conditions are strong enough to raise interest rates.

2 BUILDUP OF THE FINANCIAL CRISIS

Macroeconomists often remind us that financial crises are a natural part of business cycles and that they are bound to perhaps even to human nature itself, as behavioral biases, such as moral hazard with excessive risk-taking, tend to play an important role behind the genesis of such crises. However, the global financial crisis of 2008 was particularly intense and changed the fundamental foundations and methods of central banking. Structural weaknesses in the global financial system, severe relaxation of lending and the partial dysfunction of the interbank money markets are commonly identified causes behind the plunge of the global financial markets in the autumn of 2008.

2.1 Moral hazard on the financial market

Moral hazard played a central role behind the incidents that eventually collapsed financial markets into a deep and fundamental crisis in the autumn of 2008. A moral hazard is a behavioral bias in which one party is responsible for the interests of the other party, but the responsible party has an incentive to put their own interests first. Financial examples from moral hazard include actions and thoughts such as 1) I might sell you a financial product (e.g., a mortgage) knowing that it is not in your interest to buy it, 2) I might take risks that you then have to bear and 3) I might pay myself excessive bonuses out of funds and assets that I am managing on your behalf (Dowd, 2008). Such examples of moral hazard situations are a pervasive feature of the financial system and market economies in more general. Moral hazard increases the counterparty risk (also known as the default risk) which is the risk that one of the companies or individuals included in the transaction is unable to make the required payments.

The U.S. subprime mortgage crisis is an excellent example of moral hazard occurrence on the market. Prior to the crisis, in the “old days”, a bank had an incentive to hold the granted mortgage to maturity and thus screened and selected the borrowers carefully as default of the mortgage holder would make a loss to the bank. Because of the high possibility of default, subprime mortgages were not attractive from the lender’s point of view. However, if a lender originates a mortgage with an intention to sell it on (i.e.,

securitizing it), the incentive of not letting the borrower default loan payments is seriously weakened (Dowd, 2008). With these weakened incentives, the subprime mortgage loans appeared appealing to lenders. This Ponzi scheme originating from moral hazard and securitization of high-risk financial assets kept going as long as the house prices rose in the United States. Eventually, interest rates started to rise while simultaneously house prices plunged, and this drove the market participants who were involved in the high-risk subprime mortgages to troubles.

2.2 The U.S. subprime mortgage crisis

Prior to the meltdown of the financial markets, commercial banks and other financial institutions in the United States had indulged in risky behavior with excessive lending of credits. The biggest individual dilemma was that banks agreed mortgages without proper guarantees, which created a housing bubble in the U.S. economy. Brunnermeier (2009) states that the main reason that helped to create the massive housing bubble in the U.S. was the low interest rate environment that the Federal Reserve adopted in the aftermath of the internet bubble burst at the beginning of the millennium. Furthermore, large capital inflows from abroad affected heavily on the U.S. interest rate environment creating further pressure. Inevitably, the loose monetary policy of the Federal Reserve resulted in upward trending inflation, which created pressure on interest rates to rise as bond holders sought compensation for the rising inflation level. The Federal Funds Target Rate, which is the Federal Reserve's main tool to guide market interest rates, rose from 1.01% to 5.26% between July 2003 and July 2007. The unhealthy housing markets did not hold in such a high interest rate environment and as the subprime mortgage crisis broke in the summer of 2007, the Federal Reserve began to lower the Federal Funds Target Rate once again.

Low interest rate environment of the early 2000s encouraged investors, such as investment banks and pension funds, to engage in mortgage financing, which resulted in substantial increases in house prices. As subprime mortgages offered higher yields than standard mortgages, they were popular amongst investors as through securitization it was possible to mitigate risk and to shift a major part of the risk to other market participants. In the securitization process, the issuer designs a marketable financial instrument by pooling various financial assets into one group. The assembled

instrument is then offered to investors on the secondary market. Collateralized Debt Obligations (CDOs) are a good example of complex and pooled financial derivatives, that were used in market speculation. The combination of low lending standards and cheap credit created a housing frenzy in the U.S. planting the seeds for the financial turmoil. Laucbach and Williams (2015) find that the natural rate of interest has decreased and remained near zero ever since the Great Recession of 1929. This suggests that the low interest rate environment around the time of the U.S. housing bubble was not caused by the lax interest rate policy of the Federal Reserve but was rather created by low GDP growth rates and low inflation levels as the natural interest rate had diminished to low levels already decades earlier. However, the state of the real economy was not in line with the overheating financial markets.

In the United States, mortgages were granted under the premise that background checks are unnecessary as house prices could only increase, and thus a borrower could always refinance a loan by using the increased value of the house as a collateral (Brunnermeier, 2009). Banks did not resist this behavior – new mortgages were announced as through collateralization and securitization, banks were able to sell mortgages off from their balance sheets and by doing so, shift the associated risks to the buyer, most commonly to an investment bank. The securitization process extended beyond the mortgage market loans and included corporate and consumer loans as well. Adrian and Shin (2010) point out that by the end of the second quarter of 2007, the assets held by institutions that fund themselves through issuing securities, were larger in value than the combined total assets that credit unions, saving institutions and commercial banks held in their balance sheets.

The process of securitization offered many advantages to banks and other financial institutions. However, the complexity of these products went too far which encouraged market players to indulge in risky behavior. As the risk was decentralized to numerous market participants, eventually the whole financial system suffered from the consequences. The major financial innovation of the 20th century was eventually the main accelerator which helped to burst the U.S. housing bubble in 2007 and simultaneously revealed many weaknesses of the financial system itself (Makrevska, 2013). The U.S. subprime mortgage crisis caused severe repercussions as large

financial institutions and investment banks that were involved in the housing markets, faced serious liquidity problems and substantial credit losses.

2.3 Credit crisis and bankruptcies of large financial companies

Securitization of assets expanded credit but led to a decline in credit quality. The financial architecture had undergone a significant transformation prior to the financial crisis of 2008. Whereas loans and mortgages are traditionally kept in a bank's books, the rising popularity of securitization spurred banks to transfer the credit risk of different underlying assets to other financial institutions. As interbank lending is unsecured, the substantial increase in credit risk derived from rising counterparty risk due to the uncertainty of the banking sector's exposure to troubled assets. Furthermore, the banking sector was financing its asset holdings with instruments of short maturity which left banks particularly exposed to a dry-up in funding liquidity.

According to Brunnermeier (2009) the first big U.S. corporation to struggle was investment bank Bear Stearns. In March 2008 Bear Stearns faced worsening conditions in the financial markets as Carlyle Capital, an Amsterdam-listed hedge fund, got into trouble as its debt fund, Carlyle Capital Corp, collapsed and the Blue Wave – hedge fund liquidated. As Bear Stearns was a creditor of Carlyle Capital, illicit rumors of Bear Stearns being in a bad financial state started to spread on the market. Bear Stearns stock price collapsed from $159 to just $2 in a year. Eventually JPMorgan Chase, the biggest bank in the United States, acquired Bear Stearns for $236 million, or $2 per share.

The omens of bad regulation and lack of transparency started to show on the market. The fate of Lehman Brothers, a former large investment bank, is often considered to be the main individual incident that expanded the credit crisis to a worldwide financial crisis in 2008. Lehman Brothers was operating with an extremely high level of leverage (asset-to-equity ratio) and relied heavily on short-term debt financing. While commercial banks are regulated and cannot leverage their equity more than 15 to 1, at the beginning of the credit crisis Lehman had a leverage of more than 30 to 1, in other words only $3.30 of equity for $100 of debt. With such high leverage, a mere 3.3%

decline in the asset value wipes out the entire value of equity and thus makes the company insolvent. (Zingales, 2008.)

Lehman Brothers was accused of having sold Collateralized Debt Obligations (CDOs) to its clients while simultaneously taking short positions in these securities which eroded the value of CDOs effectively. Goldman Sachs, one of the most powerful investment banks in the world, helped its clients (such as Lehman Brothers), to short the mortgage bond market, and by doing so, helped to pull the trigger of the subprime market. With record high debt-to-equity ratio and reliance on short-term debt financing, Lehman Brothers faced insurmountable liquidity shortage in the financial market that was ravaged by the U.S. subprime mortgage crisis. However, Lehman Brothers was not the sole respondent from the massive market altering and speculation as collusion between banks was obvious. This, in turn, indicates that market surveillance and monitoring had failed big time. The rising popularity of questionable banking activities such as securitizations and off-balance sheet trading exposed serious weaknesses in bank regulation.

The failure of Lehman Brothers in 2008 was the largest case of bankruptcy in U.S. history. As Lehman Brothers announced its bankruptcy in 15th of September 2008, negative effects rippled through the market and the Dow Jones Industrial Average, stock market index that measures the stock performance of 30 large companies listed on stock exchanges throughout the United States, declined by more than 500 points, or 4.4%, by the end of the trading day (Mamun & Johnson, 2012). The effects of the bankruptcy did not limit to the U.S. markets alone but were quickly spread to the whole global economy, expanding the credit crisis from U.S. markets to the global financial markets.

The bankruptcy of Lehman Brothers and the near failure of other major financial institutions in the autumn of 2008 froze key credit markets and collapsed aggregate demand (Klyuev et al., 2009). In a stagnant credit environment commercial banks tightened their credit standards considerably as the transmission mechanism between central banks' policy rates and real economy and private borrowing rates suffered severe disruptions. Markets were not responding to policy rate announcements as expected and nonbank lending became virtually to a halt as banks increased their

margins and collateral requirements in an attempt to avoid any further losses from the situation. The actuation for the global financial crisis of 2008 was the mortgage crisis of the U.S. housing markets which finally culminated in the bankruptcy of Lehman Brothers on September 15th, 2008. With the bankruptcy of Lehman Brothers, the delusion that large interconnected financial corporations were 'too big to fail' broke, which drove the financial markets into despair.

2.4 European sovereign debt crisis

Fawley and Neely (2013) find that the financial crisis of 2008, the European sovereign debt crisis and the subsequent banking problems in Europe are intimately linked. Furthermore, there is a prevalent agreement amongst economists that the fundamental cause of the European sovereign debt crisis was the combination of the burst of the U.S. housing bubble and the credit boom which followed soon after. The European sovereign debt crisis started at the end of 2009, when the Greek sovereign, with an aggravating history of elevated government debt and deficits, started to lose credibility in financial markets. Greece revealed that its previous government had reported false information about the financial state of Greece, and that the real budget deficit of Greece was significantly higher than what was reported. As a result, Greek borrowing costs rose rapidly: in the end of April 2010, Greek ten-year bond yields moved above 8%. Greek's actions led to market panic spurring fears of a euro collapse via financial and political contagion.

The crisis in Europe mutated from a banking crisis into a sovereign debt crisis threatening the credibility of the world's second most important reserve currency, the euro (Overbeek, 2012). In the financial turmoil of the credit crisis, nearly all European governments launched sizeable stimulus programs between 2009 and 2010 to counteract the deficit of credit on global financial markets. The heterogenic euro area was facing supranational problems originating from the bleak state of the global world economy. These problems included stagnating export markets which was due to the loss of competitiveness in the international markets. By 2010, general government gross debt stood at 85% of GDP for the euro area as whole, which was considerably higher than what was agreed with the Stability and Growth Pact (SGP) agreement between the member states of the European Union in 1997. The aim of the SGP

agreement was to facilitate and maintain the stability of the Economic and Monetary Union (EMU), and it states that Member States should not have gross debt of over 60% of their GDP.

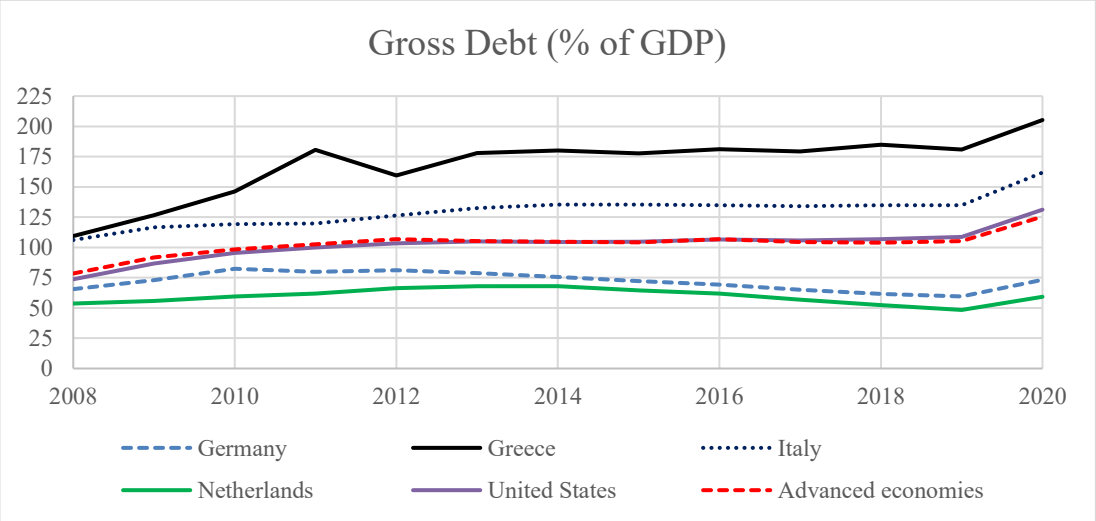

Figure 1. Gross debt (% of GDP) of chosen countries.

Figure 1 above presents the gross debt as a percentage of GDP of chosen countries from the end of 2008 to the end of 2020. The year-end data is retrieved from the IMF Public Debt Database. The debt/GDP ratios climbed as the financial crisis broke out. When the crisis broke out, the growth of the debt/GDP ratio was more rapid in the United States, than it was within strong members of EMU, such as Germany or Netherlands. However, the already high debt/GDP ratios of financially erratic euro members, such as Greece, ran out of control. Despite the high gross debt percentages, the heavy debt burden on financially more stable euro countries was not so problematic under a low interest rate environment. The European sovereign debt crisis arose from the countries with diminished credit ratings and most severe structural economic problems. The inequality between the members of the EMU was palpable: With differing credit ratings, the most problematic euro members Greece, Portugal and Ireland, were charged 4-8 percent higher interest rates, than Germany, which borrowed at 2-2.5% rate from the market.

Overbeek (2012) points out that large financial institutions played a key role in the emergence of the European sovereign debt crisis. Goldman Sachs helped the Greek

government to hide part of its debt so that Greece matched the qualifications to be a member of EMU, and thus gained membership in the common currency at the beginning of 2001. Even though Greece is often considered to be the main culprit in the outbreak of the European sovereign debt crisis, a number of other euro countries also struggle with harsh economic and financial problems. Right now, Italy is a much bigger problem for the EMU, than Greece, as it is a much larger and financially networked economy. Arguably, the EMU has structural flaws that have accentuated in the aftermath of the financial crisis of 2008. European Central Bank has responded to these challenges by keeping the key interest rates down and by launching extensive unconventional asset purchase programmes.

2.5 Ramifications from the financial crisis

The financial crisis of 2008 resulted in significant increase in debt levels across advanced economies: Gross debt across advanced economies stood at 105% of GDP as of beginning of 2020 (prior the Covid-19 pandemic) compared to 72% in 2007 (IMF Public Debt Database). Furthermore, while the banking sector in the U.S. has written off non-performing loans, the banking sector of the euro area is still retaining pre-2008 non-performing loans on their books to some extent. This number is especially high in Italy, as the World Bank estimates that 17% of the loans of Italy's banking sector are still non-performing loans.

The combination of loose monetary policy (i.e., low interest rates) and fiscal austerity that was adopted as a response to the financial crisis may have prevented the world economy from further financial meltdown, but it has also changed the architecture of economic policymaking profoundly. Central banks' balance sheets have reached unparalleled levels as central banks have interfered in regulating the financial system in addition to managing monetary policy. New tools of central banking, such as the Quantitative Easing, have artificially inflated the prices of many financial assets. By directly intervening in financial markets, central banks have lowered the expected return on targeted safe assets (securities) with their balance sheet policies and thus pushed yield seeking investors to other asset classes with a higher expected return. Majority of investors have turned to stock markets, as it has been the only option to make a return. As a result, the stock market valuation levels worldwide have risen to

record highs. The post-financial crisis development of the European and the U.S. stock markets is further explained in chapter 5.1.1.

In 2020 the global pandemic Covid-19 spread through the globe. Even though the pandemic was not a financial crisis, it practically halted the world economy. Central banks reacted with the same tools that they had adopted in the aftermath of the financial crisis. However, this time the liquidity injections to markets were greater than ever. In addition to that, the government indebtedness burst last year as the gross debt across advanced economies rose from 105% of GDP to 125% of GDP (see Figure 1). Now that it seems that the most acute phase of the Covid-19 crisis is behind us, the IMF predicts that the gross debt of advanced economies will remain more or less unchanged during the next five years.

3 MONETARY POLICY OF CENTRAL BANKS

This chapter deals with the monetary policy of central banks in general. First, the role of the central banks in the monetary system is explained after which the tools of monetary policy – conventional and unconventional – are described. The post financial crisis monetary decisions of the ECB and the Fed are compared in order to form a more comprehensive introduction of central banks' tools. After this chapter the reader should better understand the importance of central banks in terms of the functionality of the global financial markets.

3.1 The role of the central banks

Central banks are institutions that are authorized by governments to be the main respondents of monetary policy. This authorization underlines the importance of the role that central banks bear on financial markets. The effect of the monetary policy to the economy and to financial markets is based on the fact that central banks have the exclusive right to form the monetary base of the economy. This means that the central bank offers central bank funding to banks, issues notes and bonds to the public and furthermore, controls the money supply. With the given monopolistic mandate from the government, the central bank influences market conditions and controls short-term interest rates.

Bordes and Clerc (2010) state that while central banks have their own stated missions and duties, they also have two primary objectives in common: price stability and financial stability. Inflation is thus monetary phenomenon and long-term rapid inflation is often associated with the growth of money supply. Changes in the overall demand, technological development or price shocks of raw materials can also affect short-term inflation and central banks can mitigate this effect by altering the money supply which, in practice, means a change in interest rates. (Mishkin et al., 2013.) Price stability is essential, as the overall rise of price level increases the market uncertainty which might disturb the economic growth. Financial stability can be strengthened by pursuing credible monetary policy which decreases the risk premium of real interest rates. Reducing risk premium enhances the diversion of money to capital markets which improves the general investment environment and encourages investors.

Central banks have a role as a lender of last resort. This means that they provide reserves and liquidity to a bank, financial institution or in rare cases to other too-big-to-fail-institution experiencing serious and urgent financial problems. Casu et al. (2006, p. 125) argue that central banks' role as a lender of last resort has a tendency to increase the moral hazard and risky behaviour in the banking sector. However, it is naive to assume that the central bank could guarantee the solvency of every banking institution in its country.

Prior to the global financial crisis of 2008, the aim of monetary policy worldwide was to achieve low and stable inflation. Central banks' main instrument in achieving and securing the inflation targets was the short-term interest rate at which the central banks provided funding to banks. Conventional monetary policy amongst the mature economies was predictable, effective and largely successful pursuit of low inflation. However, while conventional monetary policy achieved its goals of low and stable inflation, it did not prevent market bubbles from occurring. (Joyce, et al. 2012.) The structural flaws of the market economy grew so great that the market collapse of 2008 was inevitable and no monetary policy tool, whether conventional or unconventional, could have prevented the crisis. After the crisis, central banks have been forced to focus on the financial stability of the markets in addition to ensuring that inflation meets the targets set. In recent years, the central banks have used unconventional monetary policy tools to a growing extent to ensure the financial stability of the market. The tools of monetary policy – conventional and unconventional, are presented next.

3.2 Tools of conventional monetary policy

Central banks use monetary policy tools to alter the money supply and interest rates. The most important conventional tools of modern monetary policy are open market operations, reserve requirements and key interest rates. Although this thesis processes the conventional monetary policy of the ECB and the Fed mainly through interest rate policy, other means of conventional monetary policy tools are briefly introduced as well, as they are often set up simultaneously to improve the effectiveness of monetary policy (CFA Institute, 2017). Furthermore, the difference between conventional asset

purchases through open market operations and unconventional asset purchases through quantitative or credit easing is clarified.

3.2.1 Key interest rates

This thesis considers the guiding of key interest rates to be the most important conventional monetary policy tool of the central banks. Central banks set the key interest rates in order to guide the main monetary variables in the economy. Such variables include consumer prices (inflation), credit expansion and market interest rates. Under normal times, lowering the key interest rate eases the market conditions and stimulates the economy whereas raising the key interest rate tightens the market conditions and is used to prevent overheating of the economy.

Governing Council, the main decision-making body of the ECB, sets the three key interest rates of the euro area, that are; 1) the interest rate on the main refinancing operations (ECB Refinancing Rate), which normally provides the majority of the liquidity to the banking system; 2) the rate on the marginal lending facility, which offers overnight credit to banks included in the Euro system and 3) the rate of deposit facility, which banks of the Euro system use to make overnight deposits. In this thesis, the ECB Refinancing Rate is chosen to present the interest rate policy on the euro area as a whole, as it is considered to be the main key interest rate of the ECB. ECB Refinancing Rate guides the market interest rates of the euro area and is the rate on which banks of the Euro system can borrow directly from the ECB.

Federal Open Market Committee, the monetary policy-making body of the Fed, sets the key interest rate of the U.S. economy - the Federal Funds Target Rate. The Federal Funds Target Rate is the rate on which the U.S. commercial banks borrow and lend their excess reserves to each other overnight. Bernanke and Blinder (1992) find that the Federal Funds Target Rate sensitively records shocks to the supply of bank reserves thus making the Federal Funds Target Rate a good indicator of monetary policy actions and the monetary stance of the Fed in general.

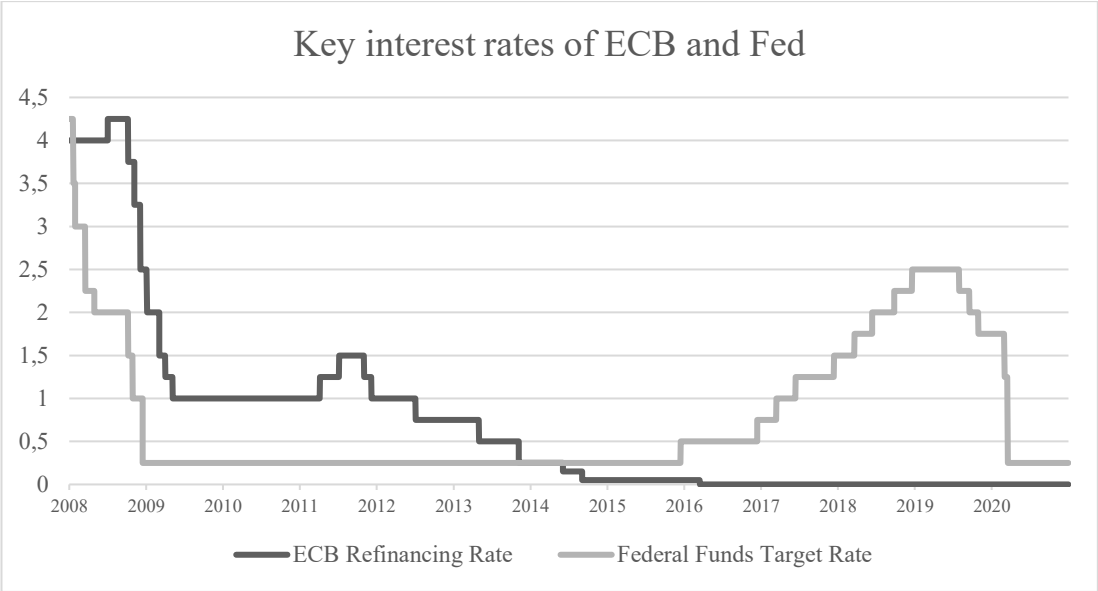

Figure 2. ECB Refinancing Rate and Federal Funds Target Rate between 01/2008-12/2020.

The ECB started to cut its primary policy rate, the ECB Refinancing Rate, from 4.25 percent in October 2008 and hit its subsequent lower bound in May 2009, when the ECB Refinancing Rate was set to 1 percent (Fawley & Neely, 2013). However, afterwards the ECB cut the ECB Refinancing Rate even more and set this primary policy rate to zero in March 2016, where it has stayed ever since.

As the global economy sank into recession in the aftermath of the financial crisis, the Fed decreased its primary policy rate swiftly: The Federal Funds Target Rate was decreased from 4.25 percent to 0.25 percent during 2008. Wright (2012) argues that the Fed hit its zero-lower bound of interest rate at that specific range of 0-0.25 and could not lower the Federal Funds Target Rate anymore without it becoming a negative one. Going below zero-lower bound could have had unintended consequences in terms of inflation, for example.

Greenlaw et al. (2018) argue that the most important and reliable tool of Fed's monetary policy is the short-term interest rate, and thus see that by altering the Federal Funds Target Rate the Fed is able to better guide the economic activity of the U.S., than by conducting large-scale asset purchase programmes. As the economic stance of the U.S. stabilized, and the market was already starting to show signs from overheating, the Fed began to gradually raise the Federal Funds Target Rate in 2016.

However, the Covid-19 pandemic forced the Fed to decrease the Federal Funds Target Rate once again to its zero-lower bound of 0-0.25 in order to provide monetary stimulus to the economy and enhance the effectiveness of asset purchases.

Whereas the U.S. operates in a consolidated union, the euro area comprises of 19 sovereign governments with separate national budget constraints. Thus, the internal threat of losing market confidence is way greater for the ECB than it is for the Fed, and due to this, the monetary policy decisions and acts of the ECB often seem sluggish when compared to the ones of the Fed. For this reason, raising the key interest rate is not as troublesome for the ECB as it is for the Fed. It can be argued that, as the economies are recovering from Covid-19, the Fed will start to raise the Federal Funds Target Rate sooner than the ECB is able to raise the ECB Refinancing Rate.

3.2.2 Open market operations

Open market operation is the most commonly used indirect monetary policy instrument in developed countries (Casu et al., 2006, p. 119). In an open market operation, the central bank either sells or purchases debt securities to the non-bank private sector. By selling debt securities to the market, the central bank absorbs money from the market resulting in interest rate increase and money supply decrease. The effects are contrary, if the central bank decides to purchase debt securities, which is like an injection of money to the markets - money supply increases and interest rates decrease. Casu et al. (2006, p. 119) argue that open market operations attract central banks as they can be easily reversed (by opposite open market operation) and can be undertaken rather quickly. Thus, open market operations are flexible and precise and usable for minor or major changes.

In traditional open market operation, the central bank lends money to the financial institutions on the secondary market and, in exchange, receives securities as collateral. Afterwards, the central bank conducts an inverse action where these received collaterals are resold and the loan received by the financial institution is repaid with interest. This inverse situation is called sterilization operation, which has a direct inverse reaction that neutralizes the effect of the open market operation to the monetary market. The difference to unconventional asset purchases is clear: In Quantitative

Easing (QE) no sterilization operations are made and thus, the balance sheet of a central bank is heavily affected as result, whereas in Credit Easing (CE) the central bank does not sell the received collaterals back to the market but keeps them in the balance sheet. Both QE and CE are explained in more detail in their own individual chapters.

3.2.3 Discount windows and standing facilities

Contrary to open market operations initiated by central banks, discount windows and standing facilities are launched by credit institutions. These monetary tools allow central banks' counterparts to regulate their overnight liquidity with their own initiative. When credit institutions borrow from central banks, the borrowing has a cost which is equal to an existing discount rate and by altering that discount rate, the central bank can influence the demand for the short-term money and thus is able to guide the short-term money supply and short-term market interest rates in the economy. Standing facilities refers to a monetary tool of the ECB whereas discount windows are used by the Fed.

The ECB uses standing facilities with an aim to control overnight liquidity and to signal the general monetary policy stance. Two different standing facilities are in use: Marginal lending facility, which allows the counterparts to obtain overnight liquidity from the National Central Banks (NCBs), and deposit facility, which allows the counterparts to make overnight deposits with the NCBs. The ECB states that normally the interest rate for the deposit facility provides a floor for the overnight market interest rate.

The Fed offers three discount window programmes to credit institutions, which all have their own interest rates. These discount windows are primary credit, secondary credit and seasonal credit from which the primary credit is the Fed's main discount window programme. Under the primary credit programme, loans to credit institutions are extended for a very short time (usually overnight) and thus are offered only to counterparts that meet sound financial conditions. Counterparts that are not eligible to receive primary credit, may receive secondary credit to meet their short-term liquidity

needs. Seasonal credit is extended only to relatively small credit institutions that have, for example, cyclical funding needs.

3.2.4 Reserve requirements

Central banks impose minimum reserve requirements to credit institutions, such as commercial banks. The required reserve should be calculated according to liabilities in the balance sheet of the credit institution and should then be held at the central bank (Gray, 2011). With reserve requirements, the central bank can stabilize market interest rates by giving credit institutions an inducement to smooth the effects of short-term liquidity fluctuations as part of their deposits are bound to the central bank.

The importance of reserve requirements as a monetary tool is diminished as central banks have recently favored open market operations, discount windows and standing facilities over reserve requirements (Casu et al., 2006, p. 122). Above mentioned monetary tools are more flexible than reserve requirements, as it is difficult to make small adjustments to the money supply via reserve requirements. As such, the role of reserve requirements in modern monetary policy is to be an instrument that reduces the risk taking of credit institutions and improves their solvency, rather than to be an actual monetary policy tool that the central banks alter and use actively.

3.3 Tools of unconventional monetary policy

Central banks were forced to turn to unconventional monetary policy measures in the aftermath of the financial crisis, as, resulting from the rapid interest rate cuts, both the ECB and the Fed faced the zero-lower bound of policy rates under which it was not possible to ease the market conditions with policy rate cuts anymore. The zero-lower bound is a macroeconomic problem that occurs when the central bank cuts it's guidance rate so drastically that the short-term nominal interest rate drops to zero or near to zero. This causes a liquidity trap which further limits the capacity of the central bank to stimulate economic growth through interest rate policy. At that level, any additional monetary stimulus is called unconventional. Furthermore, the tools of conventional monetary policy are rather inefficient once the zero-lower bound has been reached (see for example Kontonikas et al., 2013).

During market instability and market crises, implementing monetary policy is a more complex process than it is under normal market conditions. Resulting from the increase in the counterparty risk, the demand for reserves of credit institutions in financial markets rises. This causes pressure to money market rates which increases the challenges that central banks face in controlling them. Furthermore, the transmission channels of monetary policy are disrupted as a consequence of soaring financial tension and thus, the monetary policy impulse cannot be transmitted to the financial assets effectively. Proportional to the size of the economic shock and its effects on the real economy, curtailing policy rate to stimulate demand could not be adequate as the policy rate hits the zero-lower bound (Cecioni et al., 2011). Under the abnormal economic conditions resulting from the global financial crisis, central banks pursue an unconventional monetary policy to address the distortions in monetary transmission mechanism with a goal to revive the real economy.

Central banks use various measures that can be described to be unconventional – deriving from normal. These unconventional measures are used to lessen financial market tension and to stimulate real economic activity under low interest rate environment. Peersmann (2014) classifies unconventional measures into two broad categories: Forward guidance policies and balance sheet policies. The first of these two broad categories, forward guidance policies, relies heavily on using communication tools through which the central banks aim to shape the economic agents' expectations about the likely future path of monetary policy. The second broad category of central banks' unconventional measures, balance sheet policies, gathers a set of means that reflect from central banks' balance sheet to the underlying market conditions. These methods include providing liquidity to financial markets and purchasing private or public assets. Balance sheet policies can be further divided to Quantitative Easing and Credit Easing.

In this thesis, the unconventional monetary policy is classified as an additional stimulus by the central bank when the nominal interest rate has been already brought down. As such, three different tools of unconventional monetary policy are recognized: 1) Signaling and forward guidance – guiding medium to long-term interest rate expectations, 2) Quantitative Easing – expanding the size of the central bank's balance sheet and 3) Credit Easing – changing the composition of the central bank's

balance sheet. Next, these unconventional tools are further explained in their individual chapters.

3.3.1 Signaling and forward guidance

Eggertson and Woodford (2003) state that although central banks steer short-term interest rates, the monetary policy stance is more related with long-term interest rates. The market reckons long-term interest rates in borrowing and investment decisions. Yilmaz (2015) argues that long-term interest rates – having a pivotal role in monetary transmission mechanism – are determined according to the expectations of market participants on short-term interest rates as the expectations theory predicts. According to the expectations theory of the yield curve, interest rates on long-term bonds are a weighted average of current and expected short-term interest rates over the long-term bond and thus, an investor earns the same interest by investing in two consecutive one-year bond investments versus investing in one two-year bond today. Central banks affect long-term interest rates by announcing intentions about future policy rates and by altering expectations of short-term rates accordingly. If a central bank wants to influence financial markets by using forward guidance, the conducted policy should be intact even after the economic recovery supposedly strengthens. Credibility plays an important role in guidance policies – market participants should be convinced that the central bank will not renege on its commitment but continues to conduct monetary policy as previously informed. Otherwise, a time-inconsistency problem would emerge, and the announcements would not be reflected in market expectations and asset prices (Yilmaz, 2015). With forward guidance policies central banks encourage investors to shift their portfolios into long-term maturities and aim to lessen the market volatility by expressing intentions at times of distress (Issing, 2014).

Since July 2013, the ECB has provided forward guidance about its expectations for future policy rates to anchor medium-term rates at levels that are more consistent with the policy intentions of the ECB (Altavilla et al., 2015). The first time that the Fed used forward guidance to effectively alter the market environment was on 9th of August 2011, when the Fed announced that the Federal Funds Target Rate will be kept low considerably longer than what the market was expecting. The Fed indeed stuck to this announcement as seen from Figure 2. Peersman (2014) reminds that forward guidance

policies can only influence expectations, and hence longer-term interest rates and asset prices, to the extent in which they are still credible in the eyes of market participants.

3.3.2 Quantitative Easing (QE)

Asset purchases form a crucial part of central banks' balance sheet policies. By purchasing assets, the central bank aims to increase the bank reserves of the economy (Yilmaz, 2015). Under normal market conditions an increase in bank reserves is a by-product of asset purchases as the main focus lies in the price of these reserves. However, during abnormal market conditions such as crises, the aim of asset purchases is to affect the quantity of bank reserves and, due to this, this policy is foremost referred to as "Quantitative Easing" (QE). Joyce et al. (2012) find that as central banks are rising reserves, banks will expand credits to the whole economy which stimulates aggregate demand accordingly. QE has been the most high-profile form of unconventional monetary policy after the financial crisis. Friedman (2013) argues that unconventional monetary programs, such as QE, can be used as a substitute to conventional interest-rate policy. As QE is practiced in a different scale, it is often distinguished from open market operations by referring to QE as large-scale asset purchases.

According to Lenza et al. (2010) central banks are using QE when they increase their balance sheets by acquiring more "conventional assets" such as government bonds from the market. To implement an effective policy, QE does not include any sterilization operations, which distinguishes QE from conventional monetary policy of open market operation as well as from Credit Easing. When no sterilization operations are conducted, the size of the balance sheet of the central bank is increased, but the composition is not. In other words, the portfolio of assets held by the central bank is not altered.

As the central bank withdraws the purchased assets from the secondary markets, it neutralizes a part of the supply of financial assets. The yield of these withdrawn assets decreases, which transfers a part of asset demand to more risky assets. Therefore, the process of QE stimulates consumption and investments by altering the allocation of liquidity on financial markets. QE is most effective when the zero-lower bound of

interest rate is achieved, as under such circumstances the central bank does not pay any interest on its reserves (Bini Smaghi, 2009). To summarize: QE is an attempt to boost economic activity via expansion of the money supply.

3.3.3 Credit Easing (CE)

Credit Easing (CE) consists of purchases of securities by central banks either from commercial banks or directly from the securities market. The purpose of CE is to back the liquidity and the price of chosen securities. CE provides liquidity to certain market segments that are in distress through purchases of various asset classes such as commercial paper, corporate bonds and asset-backed securities. When central banks acquire these above-mentioned assets from the private sector, the risk profile of their balance sheet is affected. As such, CE shifts central banks' assets to riskier and less liquid assets, while holding the size of the balance sheet unchanged. The size of the balance sheet remains constant thanks to the simultaneous sterilization operations. (Framer, 2012.) The main difference between QE and CE is that in QE, the size of the central bank's balance sheet increases but the composition of the balance sheet remains constant, while in CE the size of the balance sheet remains constant but the composition changes. Furthermore, the first post-financial crisis large-scale asset purchase programmes of ECB were CE programmes as they are not seen as radical as QE programmes.

With CE the central banks improve liquidity in key market segments of private debt securities which reduces market interest rates further. Beirne et al. (2011) underline that CE facilitates financing conditions for firms and financial institutions as commercial banks expand their lending to the private sector. However, CE increases the credit risk of central banks, as they include riskier assets to their balance sheets.

Introduced balance sheet policies, QE and CE, can also be mixed. For example, the QE programmes of ECB include, in addition to traditional low-risk government bonds, asset purchases of more riskier asset classes such as corporate bonds and asset-backed securities. Easing with these asset classes is often perceived as typical easing for CE operations. As unconventional balance sheet policies impact the quality and the size of the central bank's balance sheet, they are clearly distinguished from conventional

asset purchase tools such as open market operations. Although unconventional asset purchases may increase the overall credit risk on the market, they appear to be necessary to redress the financial markets in situations, where conventional monetary means are not enough.

3.3.4 Consequences from the balance sheet policies

Central bank balance sheets have changed continuously, in many cases as a passive response to monetary policy actions such as open market operations (Chen et al., 2012). However, the size and composition of the balance sheet does not vary that much under open market operations. Now it seems that large-scale asset purchase programmes have replaced interest rates as the main policy instrument of central banks (Beck et al., 2019). Due to the large-scale asset purchase programmes, the size and composition of the balance sheets of the ECB and the Fed have changed considerably over the decade.

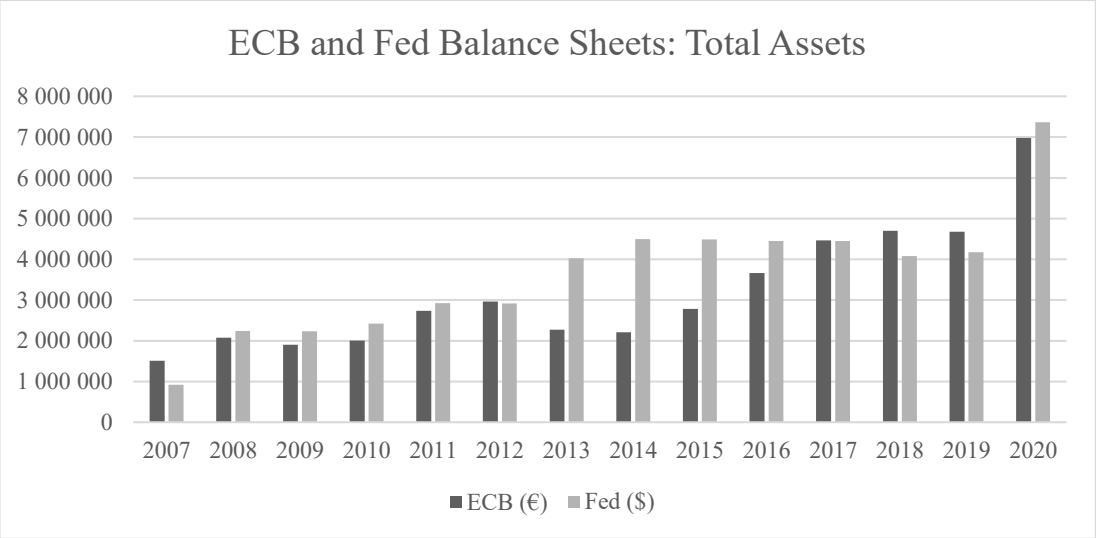

Figure 3. Total assets of ECB (€) and Fed ($) between 2017-2020.

Figure 3 above presents the evolution of the ECB's and the Fed's balance sheets after the financial crisis in terms of total assets. Year-end situation of the ECB is retrieved from the annual reports of the ECB and year-end situation of the Fed is retrieved from the Board of Governors of the Federal Reserve System. Balance sheets are shown in local currencies of the central banks: ECB in euros (€) and Fed in U.S. dollars ($). We

can easily distinguish the asset purchase programmes of the ECB and the Fed from Figure 3, as they have had a direct effect on the size of the balance sheets of these central banks.

A direct implication of eased liquidity provision to the market was the increase in the size of the ECB balance sheet: Between 2007 and mid-2012, the size of the ECB's balance sheet more than doubled (Constâncio, 2018). Between 2012 and early 2015 the ECB eased monetary conditions through interest rate cuts (see Figure 2) and was able to reduce the size of the balance sheet. However, in 2015 the ECB launched its first QE programme consisting of multiple different programmes under which monthly large-scale asset purchases have been made. These purchases have resulted in an upward trend in the size of the ECB's balance sheet.

During the financial crisis and subsequent recession, Fed's total assets increased significantly from $0.9 trillion in the beginning of 2008 to $4.5 trillion in early 2015. Fed's total assets remained relatively constant between 2015 and 2017 until it started the Federal Open Market Committee's balance sheet normalization programme, which took place between October 2017 and August 2019. Under the normalization programme, the Fed decreased its total assets to under $3.8 trillion. In September 2019, the total assets held by the Fed started to increase again.

The Covid-19 pandemic required large responses from all of the major central banks. When the asset prices are in a downward spiral, large-scale asset purchases are highly effective and especially when the interest rates are pressed down (see Figure 2). By conducting large-scale asset purchases, the ECB and Fed were able to reverse the downward spiral and provided confidence to stock markets (see Figure 5 and Figure 6). As a result, the total assets that the ECB and the Fed hold in their balance sheets have skyrocketed (see Figure 3).

4 MONETARY TRANSMISSION MECHANISM

Monetary policy decisions affect the economy through a so-called monetary transmission mechanism. The transmission mechanism is a complicated and networked entity, which forms from the economic dependencies of different variables. Ireland (2005) describes monetary transmission mechanism as the effect of a change in nominal money stock or nominal short-term interest rates on real variables such as aggregate output and employment. The monetary transmission mechanism of a standard interest-rate policy is based on a group of theories that are relatively consistent, but the monetary transmission mechanism of unconventional policies is not so well known, nor studied. Today, understanding the monetary transmission mechanism is perhaps more important than ever, as central banks have adopted the use of unconventional monetary policy tools while, simultaneously, more traditional tools have been restricted by the zero bound of interest rate.

At the wake of the financial crisis the monetary transmission mechanism suffered heavy distortions and as a result, market participants reacted weakly to monetary impulses sent through traditional interest-rate policies. Wright (2012) describes that distortions in the monetary transmission mechanism were caused by the impending zero-lower bound, which caused the inability to cut main interest rates any further, even though the natural interest rate was already negative. Furthermore, there was a sharp increase in demand for reserves in the financial system which limited the redistribution of liquidity between financial institutions and reduced the capability of central banks to control market interest rates further. Distortions in the transmission mechanism under abnormal market conditions are visible when market participants see interest rate cut, that under normal market conditions eases the market conditions, as a sign from worsening economic conditions which results in a negative market reaction. As the monetary transmission channel of traditional monetary policy tools was not working, central banks were forced to take more unconventional methods under consideration. The implementation of unconventional monetary policy tools by the leading central banks at the wake of the financial crisis of 2008 has been the most significant shift in the practice of central banking during recent years. Unconventional monetary policy transmission mechanisms include three broad channels: The signaling channel, the portfolio balance channel and the liquidity channel. (Janus, 2016.)

The effectiveness of transmission of the monetary stimulus through signaling channel relies heavily on the credibility of a central bank. Taking the assumption of financial markets efficiency under consideration, we can distinguish the so-called announcement effect, that captures the direct impact of new information releases from central bank's use of unconventional monetary policy tools to the market. Bauer and Rudebusch (2013) argue that signaling channel includes stimulation of inflationary expectations, fall of the real interest rates, changes in the term structure of market interest rates and increase in investments and the overall demand. Large-scale asset purchases send a signal that the short-term interest rates are most likely to remain low and such an expectation will also lower long-term rates. Furthermore, this signal supports the stock market price development.

The portfolio balance channel is based on theories of imperfect substitutability of assets. Therefore, the central bank can impact on market participants decisions by altering the value and composition of its assets. Bowdler and Radia (2012) find that the central bank's market availability diminishes when it starts to buy a chosen asset class due to the so-called local supply effect. When a central bank executes transactions in financial markets, such as the purchasing of government debt, it raises the demand for sovereign debt which increases the price of existing bonds while lowering the interest paid (Falagiarda & Reitz, 2015). Simultaneously, market participants rebalance their portfolios within the segment that the central bank just altered with its asset purchases. Profit seeking investors shift to more riskier assets in order to receive higher returns. Through portfolio balance channel, large-scale asset purchase programmes have encouraged private sector individuals to allocate their capital especially to the stock markets.

According to the liquidity channel of unconventional monetary policy transmission mechanism, the use and effects of central banks' unconventional tools should be viewed through the increase in central banks' liabilities and reserve supply. Thus, unconventional policies are closely bound to the improvement of financial institutions' balances which increases the overall availability of external financing to market participants. Monetarists often argue that the importance of the liquidity channel derives from the fundamental differences between the monetary base, which is controlled by central banks, and other market assets. Therefore, as the effects of

unconventional monetary policies are dependent on the shifts in central bank's liabilities, an increase in monetary base should cause changes in broader monetary aggregates even under the current zero-lower bound of the euro area (Janus, 2016). Through the liquidity channel, banks increase the offering of commercial, industrial and real estate lending. This leads to positive liquidity shock, which also contributes favorably to the development of the stock markets.

Mishkin et al. (2013) argue that the effectiveness of the monetary transmission mechanism might be different in different economies as the transmission mechanism is dependent on variables such as the level of openness, degree of financial debt and possible frictions of the economy. As such, the monetary transmission mechanism should be more efficient in advanced economies than in emerging economies. Theoretical models of unconventional monetary policy transmission mechanism are not as sophisticated as models considering conventional monetary policy transmission mechanism are, and due to this, it is hard to fully explain the impact of changes in central banks' balance sheets on financial markets. Reaching zero-lower bound of interest rate has limited the options of conventional monetary easing such as interest rate cuts, but the monetary transmission mechanism functions also in the zero-interest rate environment (Mishkin et al. 2013).

4.1 Monetary policy and stock prices

Stock prices are among the most closely monitored asset prices and are commonly regarded as being highly sensitive to economic conditions (Ioannidis & Kontonikas, 2008). According to the discounted cash flow model, stock prices are equal to the present value of expected future net cash flows. Monetary policy should then play an important role in determining stock returns either by altering the discount rate used by market participants (e.g., by guiding key interest rates) or by influencing market participants' expectations of future economic activity and conditions.

Cassola and Morana (2002) find that liquidity preference shocks are the most important determinant of real stock market price index volatility in the short-term. Monetary easing through balance sheet policies aims to increase the liquidity available, and announcements of large-scale asset purchase programmes are a textbook example

of positive liquidity shocks. Cassola and Morana also find that permanent monetary surprises have a strong, yet temporary, impact on the stock market. Since the financial crisis, the monetary policy of ECB has headed to a direction where interest rates are kept around the zero-lower bound and monetary easing is provided through balance sheet policies. As the debt/GDP ratios of euro area countries have swollen and the economic growth stalled, it is not expected that the ECB will change the direction of its monetary policy in the near future.

4.1.1 Market efficiency

One of the key theoretical aspects related to studying the effect of large-scale asset purchase announcements on stock returns is the efficiency of the stock markets. According to Fama (1970), market efficiency causes current stock prices to always incorporate and reflect all relevant and available information. This fundamental concept is known as the efficient market hypothesis and event studies often rely on the semi-strong form of it. Fama (1970) divides market efficiency into three common forms. The weak form efficiency assumes that there are no patterns to stock prices and thus the stock prices must move randomly. Semi-strong form of market efficiency assumes that share prices reflect all publicly available information in an unbiased way and as such, should adjust quickly to reflect any new relevant information. Strong form of market efficiency assumes that in addition to any public information, stock prices reflect private information as well and according to it, no one, including insiders, can earn excess returns on the stock market.

In terms of this thesis, the semi-strong form of market efficiency is considered, as the ECB's asset purchase programme announcements represent public information. The aim is to determine, whether the release of new public information generates measurable and significant abnormal return on an index level, or not. If the semi-strong form of this hypothesis holds, the current stock prices are correct and all new information will lead to an immediate price reaction.

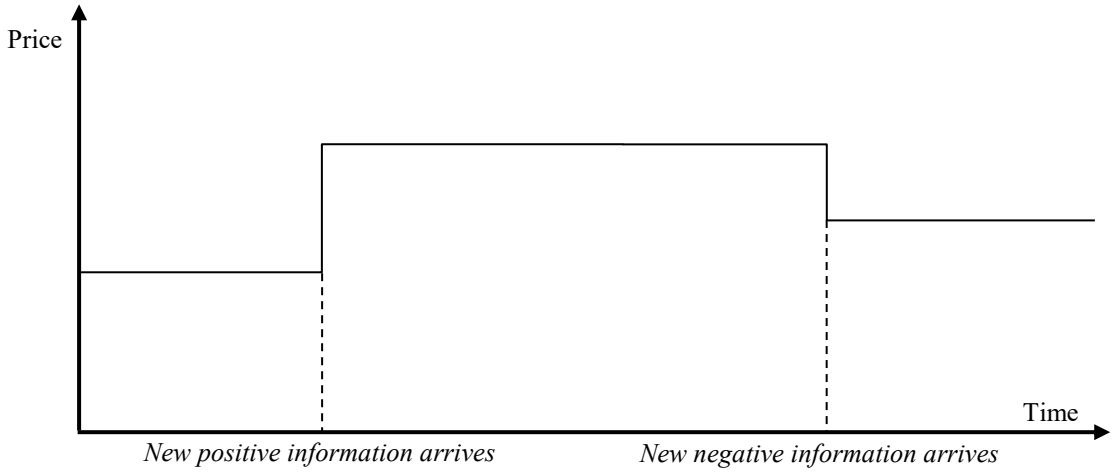

Figure 4. Market efficiency in case of new information.

Figure 4 above presents the predicted price change of a stock price, if a semi-strong form of efficient market hypothesis holds. Announcing new large-scale asset purchase programmes represent new positive information that should spread to the economy, including the stock markets. Leaning on this, we can assume the euro area stock price reaction of chosen events to be positive. If no significant intraday effect is detected, it would be a sign of market inefficiency.

4.1.2 International integration of stock markets

In addition to market efficiency, the international integration and co-movement of stock markets is a relevant issue for this study as the possible announcement effect of ECB's asset purchase programmes is measured from the U.S. stock markets (S&P 500) as well. Chen (2018) reminds that increased economic globalization and international capital flows have accelerated financial market linkages across the countries in recent decades. As the financial integration goes deeper, the correlations between stock markets become stronger. A good example of deep financial integration is the financial crisis which started from the unhealthy U.S. housing markets and spread quickly to the world economy causing a worldwide market collapse. However, since the financial crisis the European and the U.S. stock markets diverged and followed very different recovery paths. Resulting from differing recovery paths, the performance of these

stock markets has differed a lot during the last decade. Reasons behind this are discussed further in chapter 5.1.1.

There is a wide variety of theoretical and empirical studies on the international integration and co-movement of stock markets. For example, Ioannidis and Kontonikas (2008) investigate the impact of monetary policy on stock returns in thirteen OECD countries over the time period 1972-2002 and find that changes in monetary policy affect stock returns significantly. Their results remain largely unchanged, when the increasing co-movement among international stock markets is taken into account. Jiang et al. (2017) find that the correlation of stock markets between the United States, Britain, Germany, Japan and Hong Kong has enhanced notably after the financial crisis. Furthermore, previous studies have also indicated that especially the U.S. stock market presents co-movement relationships with other developed markets such as the European stock market. Assuming that the efficient market hypothesis holds and that co-movement among international stock markets exists, we can expect that the average stock market reaction of both European stock market (STOXX Europe 600) and U.S. stock market (S&P 500) to chosen events is positive.

5 DATA AND METHODOLOGY

5.1 Data collection and description

The purpose of the event study conducted in this thesis is to measure the announcement effect of ECB's asset purchase programmes on two separate indices: STOXX Europe 600 and S&P 500. To achieve this goal, the daily closing prices of STOXX Europe 600 and S&P 500 are obtained from Yahoo Finance throughout the whole sample period from January 1st of 2008 to December 31st of 2020. Following subchapter 5.1.1 presents the chosen indices in more detail.

From the beginning of 2008 to the end of 2020 nine different purchase programmes of ECB are identified and studied. Announcements are made by the Governing Council of ECB and are further explained in subchapter 5.1.2. The announcements of the purchase programmes shatter across the sample period quite evenly, which increases the generalizability of the findings. Furthermore, the announcements include both QE programmes and CE programmes (see Table 2).

5.1.1 STOXX Europe 600 and S&P 500

This thesis uses STOXX Europe 600 index as a representation of the European stock markets and S&P 500 index as a representation of the U.S. stock markets. These indices are chosen as, arguably, the S&P 500 index is the leading large-cap index to represent stocks traded on the U.S. stock exchanges. Due to its broad market exposure, the STOXX Europe 600 index is often quoted as the European equivalent of the U.S. focused S&P 500 index. All in all, the chosen indices describe the stock market behavior and regional differences of Europe and U.S. relatively well.

Figure 5. STOXX Europe 600 index between 01/2008 and 12/2020.

Figure 6. S&P 500 index between 01/2008 and 12/2020.

Figure 5 and 6 present the daily closing prices of STOXX Europe 600 and S&P 500 during the given time-period. Since the financial crisis, the development of S&P 500 has been much more straightforward than the one of STOXX Europe 600. As the price of S&P 500 has more than doubled from the beginning of 2008, the STOXX Europe 600 only recently passed the price of the early 2008. To interpret this significant difference between the chosen indices, two major explanatory factors are distinguished. Firstly, structural problems overshadowed the European economy throughout the last decade. When the U.S. economy accelerated to growth after the

financial crisis, Europe sank into the sovereign debt crisis. The clouds above the European economy and cooperation became even gloomier when the United Kingdom held a referendum considering the European Union membership. On 23rd of June 2016, the United Kingdom voted to withdraw from the European Union.

Secondly, the past decade was a winning parade for the U.S tech stocks, during which the market value of such companies soared significantly. At the end of 2020, the top three weighted stocks of S&P 500 were 1) Apple Inc., with an index weight of 6.7% and market capitalization of $2.232 billion, 2) Microsoft Corp., with an index weight of 5.3% and market capitalization of $1.682 billion and 3) Amazon.com Inc., with an index weight of 4.4% and market capitalization of $1.634 billion. Concurrently, three top weighted stocks of STOXX Europe 600 were 1) Nestle SA, with and index weight of 3.1% and market capitalization of $339 billion, 2) Roche Holding AG, with and index weight of 2.3% and market capitalization of $300 billion and 3) Novartis AG, with an index weight of 2.1% and market capitalization of $215 billion.

In early spring of 2020, the Covid-19 shock ravaged the stock market as the risk-tolerant economic agents living in uncertainty offloaded the risky assets from their portfolios. In a matter of weeks, both STOXX Europe 600 and S&P 500 (and also other stock indices around the globe) plunged over 30%. Looking back, the U.S. stock market has recovered faster from the Covid-19 pandemic than Europe as the price of S&P 500 is already clearly above the pre-pandemic price level whereas STOXX Europe 600 has not yet reached the pre-pandemic price level (see Figure 5 and Figure 6). One major reason for this is that the top weighted industries of S&P 500 (see for example top three weighted stocks mentioned above) remained relatively strong and were able to make a quick recovery when more traditional manufacturing industries that are represented in larger proportion in STOXX Europe 600 have understandably experienced the shock as more severe and prolonged.

5.1.2 ECB's asset purchase programmes

This subchapter presents the asset purchase programmes of ECB whose announcement effect on the chosen indices is later studied in the event study section of this thesis. The Governing Council is the main decision-making body of the ECB and is thus responsible for decisions relating to monetary objectives on the euro area. Furthermore, the Governing Council is the first party to present selected monetary policy guidelines to the public. When this thesis refers to decisions of the ECB, it is referring to decisions and statements made by the Governing Council.

Considering international standards, the ECB was a late comer to the group of central banks engaged in unconventional monetary policy (Lombardi, et al., 2018). This is especially true with the Quantitative Easing (QE) programmes as the first QE programme was introduced as late as in the early 2015. For comparison, Fed introduced its' first QE programme already on 25th of November 2008. In this respect, it is notable that the ECB started its QE programme in relatively calm times. Before the first QE announcement, the ECB was easing through CE programmes.

First and Second Covered Bond Purchase Programmes (CBPP1 & CBPP2)

According to Fawley and Neely (2013) the ECB's major cuts to the ECB Refinancing Rate between 2008 and 2009 were not enough to calm the distressed markets, where concerns over counterparty risks still existed. As a result of market tension, by early 2009 the interbank lending of the euro area had dried up. The ECB responded to this market failure with introducing its first asset purchase programme on 7th of May 2009, when the First Covered Bond Purchase Programme (CBPP1) was introduced to the public. While other central banks (e.g., Fed and the Bank of England) were conducting QE through large-scale purchase of domestic government bonds, the ECB was determined to provide exceptional liquidity measures to banks through the purchase of other asset classes.

ECB conducted the first purchases under the CBPP1 programme on 2nd of July 2009. According to its name, the CBPP1 programme targeted covered bonds, which are long-term debt securities issued by credit institutions. Covered bonds are used to refinance

loans to the public and private sector and prior to the financial crisis of 2008, the markets for covered bonds in the euro area had grown strongly. Covered bonds have some clear advantages and specific legal characteristics of "double protection" as they are secured by a protected group of high-quality assets such as public sector debt or mortgage loans and, in addition to that, they grant their holder a privileged claim on the pool of cover assets upon possible default of the issuer. The bankruptcy of Lehman Brothers, and the financial crisis of 2008 in more general, impaired the investors' confidence and shaped investors' preferences towards less risky asset classes such as government bonds. With an increase in risk avoidance, covered bonds became less attractive. To prevent the covered bond market from failing, the ECB implemented the CBPP1 programme with purchases of €60 billion in covered bonds. The programme was implemented gradually between July 2009 and June 2010 and eventually reached the intended nominal value of €60 billion in purchases.

As the euro area did not recover from the sovereign debt crisis by 2011, the ECB decided to launch the Second Covered Bond Purchase Programme (CBPP2). Details regarding CBPP2 were announced to the public on 3rd of October 2011. CBPP2 was slightly smaller than its predecessor CBPP1 and included purchases of covered bonds in both the primary and the secondary markets with a worth of €40 billion. However, by the end of the CBPP2 programme in October 2012, the ECB had bought only €16.4 billion worth of covered bonds. The lack of covered bond issuance was the main reason why the CBPP2 was not implemented to its full size. (Bibow, 2015.)

Securities Market Programme (SMP)

Cour-Thimann and Winkler (2013) argue that as the European sovereign debt crisis began to influence the markets in early 2010, acute market expectations and worries about a possible Greek sovereign debt default with a further risk of impact on sovereign debts of Ireland, Italy, Portugal and Spain started to emerge. As a response, the ECB announced the Securities Market Programme (SMP) on 10th of May 2010 which focused on buying government bonds from troubled euro countries. When announced, the ECB did not give any details about the size or the intended length of the SMP.

The SMP aroused disagreement amongst economists and critics of the SMP argued that the ECB was overstepping its mandate by buying government bonds (public debt) in secondary markets and that the bond purchases would not only undermine the ECB's credibility, but also increase the inflationary pressures on the euro area. However, the ECB assured that the SMP was temporary and merely aimed to improve the transmission mechanism of monetary policy, which had suffered heavy distortions from the financial crisis. To distinguish the SMP from QE that the Fed was implementing in the U.S., the ECB decided to sterilize the SMP purchases with specific operations that were designed to reabsorb the injected liquidity. As result from the sterilization operations, the SMP purchases had no effect on the monetary policy stance of the ECB.

The first round of SMP purchases was limited to the most problematic government bonds of the euro area: Greek, Irish and Portuguese. However, as the European sovereign debt crisis re-intensified, the ECB decided to implement a second round of SMP purchases in August 2011 and included also government bonds of Italy and Spain into the programme. When market conditions began to normalize in early 2012, the ECB stopped the government bond purchases of SMP. Fratzscher et al. (2014) find that in February 2012 the ECB held around €220 billion worth of sovereign bonds of euro countries that were experiencing financial stress. The SMP programme was officially deactivated in September 2012 while it was replaced by a new programme called Outright Monetary Transactions (OMT).

Outright Monetary Transactions programme (OMT)

The European sovereign debt crisis re-intensified once again in the summer of 2012, when the solvency of Italy and Spain became unsure. At this point the markets started to question the viability of the common currency, euro. As the possibility of euro area break up arose, Mario Draghi, the former president of the ECB, gave the famous speech on 26th of July 2012, where he stated: "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." Swiftly after the speech, on 6th of September 2012, the ECB introduced the OMT programme, under which the ECB promised, if necessary, to purchase unlimited quantity of short-term maturity government bonds issued by countries under the European Stability

Mechanism (ESM) macroeconomic adjustment programme or precautionary programme (Fratzscher et al., 2014).

As the OMT programme included the possibility to buy unlimited amounts of government bonds of a financially distressed euro country, the ECB set strict conditions for the programme. To activate the OTM programme towards a specific country, four conditions had to be met. First, the country must have received financial support from ESM. Second, the government must comply with the reform efforts that are required by the respective ESM program. Third, the OMT programme can only start if the troubled country has regained complete access to private lending markets. Fourth, the country's government bond yields are higher than what is justified based on the economic data of the country. As no country has yet met the strict requirements stated above, the OMT programme has not been activated (Acharya et al., 2015). Furthermore, Siekmann et al. (2015) remind that in addition to the fact that the OMT has not been used yet, even the legality of its usage has been discussed in courts.

Expanded Asset Purchase Programme (APP)

The ECB faced political and legal opposition to asset purchases and undertook its first large QE programme in pursuit of monetary policy objectives in January 2015. The first QE programme of ECB goes with the name of Asset Purchase Programme, and it is still ongoing. The Asset Purchase Programme (APP) of ECB is an umbrella term for four different purchase programmes: The Third Covered Bond Purchase Programme (CBPP3), the Asset-Backed Securities Purchase Programme (ABSPP), the Public Sector Purchase Programme (PSPP) and the Corporate Sector Purchase Programme (CSPP).

ECB announced two new asset purchase programmes on 4th of September 2014: Third Covered Bond Purchase Programme (CBPP3) and Asset-Backed Securities Purchase Programme (ABSPP). When announced, the ECB did not provide any detailed information about the intended size of purchases under these programmes and they were subsequently incorporated into the APP programme. Although the ECB has already launched three purchase programmes that target specifically covered bonds, these programmes have resulted only in a modest increase in covered bond prices in

the euro area (Gibson et al., 2015). Under the ABSPP the ECB buys Asset-Backet Securities directly from banks with an aim to free up their balance sheets and boost lending to euro area businesses.

On 22nd of January, the ECB decided that asset purchases should be expanded and included the Public Sector Purchase Programme (PSPP) under ongoing programmes. At the same time, the ECB shed a light on the overall size of its purchase programmes and announced that CBPP3, ABSPP and PSPP form APP and that the combined monthly purchases of APP will start from March 2015 with €60 billion. PSPP includes securities with a residual maturity ranging from 1 to 30 years and the allocation of purchases goes as follows: 90% to government bonds and 10% to securities issued by international organizations and multilateral development banks (Lehment, 2018). As PSPP identifies as QE, it has had a significant effect on the size of the ECB's balance sheet.

Corporate Sector Purchase Programme (CSPP) is the latest sub-programme of APP and was introduced to the public on 10th of March 2016 with initial monthly purchases of €20 billion. The CSPP is a decentralized programme and aims to bypass the banking sector by transmitting monetary policy stimulus directly to the non-bank sector. This is done by purchasing bonds and commercial paper issued by non-financial corporations located in euro area countries.

Even though the programmes of APP differ considerably by size and scope they also share common features. Firstly, all APP programmes are open-ended and are intended to continue until the ECB sees the inflation rate back on a sustainable track close to 2%. Secondly, since the ECB is not owned by the national government but by all the National Central Banks from each member state, the majority of asset purchases under APP are conducted in the domestic market of each National Central Bank according to the respective capital shares in ECB. (Urbschat & Watzka, 2020.) Table 1 below summarizes each individual programme of APP indicating that the PSPP is by far the largest.

Table 1. APP overview. Monthly net purchases and holdings in the end of 2020.

Program	Monthly net purchases	Total holdings*	In percent	First purchases
CBPP3	1 529	287 545	9.88	October 2014
ABSPP	-656	29 497	1.01	November 2014
PSPP	17 822	2 341 607	80.49	March 2015
CSPP	2 378	250 403	8.62	June 2016
APP	**21 073**	**2 909 052**	**100**	

* At amortized cost, in EUR millions, at month-end December 2020

The APP net purchases were carried out until the end of 2018 with a total amount of €2.6 trillion. However, given an unexpected slowdown in the euro area economy, the ECB decided to restart the APP on 12th of September 2019 with a monthly pace of €20 billion starting from November 2019. The Governing Council of the ECB expects APP purchases to continue until the ECB starts to raise its key interest rates once again.

Pandemic Emergency Purchase Programme (PEPP)

The global pandemic, Covid-19, froze the world economy during 2020. Although the ECB had already restarted the APP in the last quarter of 2019, it soon became clear that the APP itself was not sufficient enough to respond to the economic shock caused by the pandemic. On 18th of March 2020 the ECB announced that it will start a new temporary asset purchase programme, Pandemic Emergency Purchase Programme (PEPP), with an aim to support the liquidity and the financial conditions of all sectors of the euro area economy. Initial size of the PEPP was announced to be €750 billion and the purchases were targeted to securities from both the private and public sectors.

5.2 Event study methodology

The objective of an event study is to assess the extent to which market participants can earn excess or abnormal stock returns from an event that carries new information to the market. The abnormal return is the difference between the observed return and the expected return in the absence of the event. (Sorescu, et al., 2017.) Event studies often examine firm specific announcements (e.g., the appointment of new CEO) or

announcements made by regulatory bodies (e.g., ECB), and are widely deployed on the fields of accounting, finance and economics. Underlying event study methodology is a semi-strong form of market efficiency, which makes following assumptions: 1) stock prices reflect all publicly available information and 2) stock prices instantly change to reflect new information when it becomes available (Fama, 1970). Following subsections represent the event study methodology in more detail and the descriptions and formulas are based on a study by MacKinlay (1997).

5.2.1 Events of interest

As this thesis aims to capture the pure announcement effect, the event days are the days, when the Governing Council of ECB first introduced each purchase programme to the public instead of the days when the programmes have actually started (e.g., first purchases made under each). Events of interests are explained in more detail in subchapter 5.1.2.

Table 2. Events of interest.

n	Event date	Programme	Part of APP (X = yes)	Initial size	Type
1.	2009-05-07	CBPP1		€60 billion total	Credit Easing
2.	2010-05-10	SMP		Not specified	Credit Easing
3.	2011-10-03	CBPP2		€40 billion total	Credit Easing
4.	2012-09-06	OMT		Not specified	Credit Easing
5.	2014-09-04	CBPP3 & ABSPP	X	Not specified	Credit Easing
6.	2015-01-22	PSPP	X	*€60 billion monthly	Quantitative Easing
7.	2016-03-10	CSPP	X	€20 billion monthly	Credit Easing
8.	2019-09-12	APP restart		€20 billion monthly	Quantitative Easing
9.	2020-03-18	PEPP		€750 billion total	Quantitative Easing

* Monthly purchases of PSPP, CBPP3 and ABSPP were combined to cover €60 billion monthly

5.2.2 Estimation period and event window

To conduct an event study, an event window and estimation period are selected. The day of the announcement is the event day and is thus defined as t = 0. Three-day event

window of [-1, +1] is used in order to capture the short-term effects of the announcement. Taking one day prior to the event day allows the fact that investors and other market participants often have rational expectations and anticipations considering the magnitude of the upcoming announcement. Including plus one day after the event to the event window allows for the fact that it can take some time before the market adapts to the announcement made on the event day. Moreover, MacKinlay (1997) recommends the usage of a three-day event window of [-1, +1].

Although estimation period is often relatively long, Sorokina et al. (2013) remind that there is no uniform agreement on the length of the estimation period. As such, a relatively short estimation period of 30 days is chosen, as by choosing a short estimation period, the normal market behavior right before the announcement is better recorded. As the estimation period should be defined prior to the event window, and any overlapping with the event window should be avoided, the 30-day estimation period for this study is thus [-32, -2].

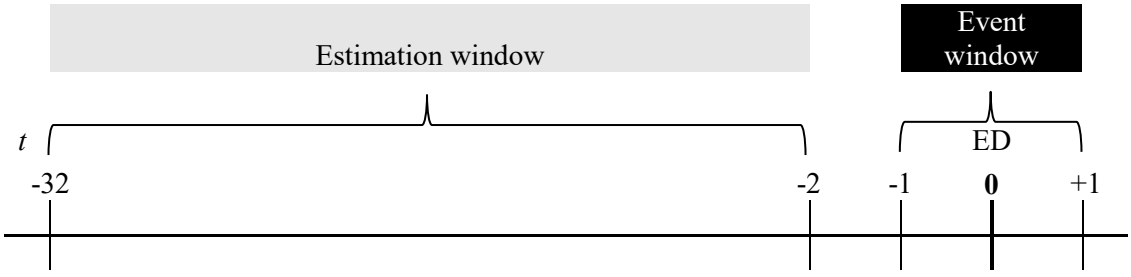

Figure 7. Estimation window and event window.

5.2.3 Measuring normal returns

Normal return of a stock represents a theoretical or expected return under circumstances, where the event is not occurring. In this study, stock indices are used instead of individual stocks, so in the context of this study stock = index. The component of actual return that is not predicted by the normal market movement alone

is called abnormal return (AR). To clarify, AR is the return difference (be it positive or negative) between a stock's actual return and normal return. As such, for stock *i* and event date *t*, the abnormal return, $AR_{i,t}$, is the difference between the stock's actual return $R_{i,t}$, and the expected return $E(R_{i,t}|X_t)$ at time *t*:

$$AR_{i,t} = R_{i,t} - E\left(R_{i,t}\middle|X_t\right) \quad (1)$$

where X_t represents the conditioning information at time *t*. In order to calculate abnormal returns, the normal return must be modelled. MacKinlay (1997) presents three popular ways to model the normal return: 1) the constant mean return model, 2) the market model and 3) the adjusted market model. From these models the constant mean return model is chosen as the study is done by comparing index against itself in order to distinguish possible significant abnormal return patterns around the event. Should the comparison be specific stock against index, the market model and its variations would be used. Although the constant mean return model is conceivably the simplest model for event study, Brown and Warner (1980, 1985) find that it often yields results that are similar to the results of more sophisticated models.

Constant mean return model assumes that the normal return for stock *i* can be calculated simply by computing the mean return from the past returns of the stock:

$$R_{i,t} = \mu_i + \varepsilon_{i,t} \quad (2)$$

$$E\ (\varepsilon_{it} = 0) \qquad var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2$$

where $R_{i,t}$ is the return of stock *i* at time *t,* μ_i is the mean return for the stock *i* and $\varepsilon_{i,t}$ is the disturbance term for stock *i* at time *t* with an expectation of zero and variance $\sigma_{\varepsilon_i}^2$.

5.2.4 Measuring abnormal returns

As expressed in Formula 1, the abnormal return of a stock is simply the return difference between the stock's actual and normal return. In theory, if no events occur,

the abnormal return of a stock should be zero. The formula for estimating abnormal returns when the constant mean model is applied to measure the normal return is:

$$AR_{i,t} = R_{i,t} - \overline{R}_i \tag{3}$$

where $\overline{R}_i = \frac{1}{T_1 - T_0} \sum_{t \in [T_0, T_1]} R_{i,t}$.

The abnormal return in the event window is the return of stock *i* on day *t* minus the average return of stock *i* in the estimation period. As the aim of this thesis is to determine, whether the ECB's unconventional purchase programme announcements create measurable and statistically significant short-term abnormal return (with three-day event window and 30-day estimation period), the daily average abnormal returns (AARs) for the chosen indices, STOXX 600 Europe and S&P 500, are calculated for each day in the event window. The formula for calculating the stocks' average abnormal return AAR_t for period t is defined as:

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \tag{4}$$

5.2.5 Measuring cumulative abnormal returns

The observations of abnormal returns are collected and accumulated to conduct more comprehensive analysis of the event of interests. Cumulative abnormal return (CAR) across the event window t_1 to t_2 for stock *i* is the sum of the ARs included in the event window:

$$CAR_i(t_1, t_2) = \sum_{t=t1}^{t_2} AR_{i,t} \tag{5}$$

Similarly, the average abnormal returns (AARs) can be further applied to be accumulated over the event window t_1 to t_2 by using the following formula of cumulative average abnormal returns (CAAR):

$$CAAR(t_1, t_2) = \sum_{t=t1}^{t_2} AAR_{i,t} \quad (6)$$

The CAARs are calculated to analyze whether the returns are abnormal and generalizable (i.e., including all chosen events of interest) during specified periods. This means that, in the context of this study, the CAARs show whether cumulative abnormal returns for STOXX Europe 600 and S&P 500 are found between the chosen three-day event window of [-1, +1] and whether the cumulative abnormal return during the event window is generalizable among the events of interest.

5.2.6 Measuring the statistical significance

To get reliable results, it is crucial to test whether the estimated abnormal returns are statistically different from zero or not. In order to make conclusions considering the statistical significance of the abnormality, two hypotheses are set: null hypothesis (H_0), which states that the abnormal returns of chosen indices around the events are zero, and opposing alternate hypothesis (H_1), which states that the abnormal returns around the events differ from zero (i.e., there are measurable abnormal returns):

$$\boldsymbol{H_0}: abnormal\ returns\ around\ events = 0$$

$$\boldsymbol{H_1}: abnormal\ returns\ around\ events \neq 0$$

If the null hypothesis is accepted, it means that there are no measurable announcement effect and if the alternate hypothesis is accepted it means that measurable announcement effect is found. There are several test statistics that can be used to measure the statistical significance of the results and to determine, which of the two hypotheses presented above is accepted. Significance tests can be divided into two broad categories: 1) parametric and 2) nonparametric tests. The key difference is that parametric tests assume that abnormal returns are normally distributed, whereas nonparametric tests do not make such assumptions. Parametric tests are based on the widely known method called the t-test. Subsequently, scholars have developed variations from the t-test to fix the prediction error of the t-test. Boehmer, Musumeci and Poulsen (1991) argue that there are dilemmas related to the frequently used

methods for measuring the statistical significance (e.g., Chi-Square, sign test and t-tests). They state that the dilemmas are caused by the variance occurred due to the event which causes these frequently used methods to reject the null hypothesis too often and incorrectly. Consequently, Boehmer et al. (1991) present a modified standardized cross-sectional method called the BMP-test. Differing from the t-test, the BMP-test is robust to the variance induced by the event. However, Kolari and Pynnönen (2010) find that the BMP-test ignores cross-section correlation and propose a modification to the BMP-test which takes account of the cross-sectional correlation. The modification is called the adjusted BMP-test and it is robust to the problems with the standard t-test - variance changes and cross-correlation. This thesis uses the adjusted BMP-test proposed by Kolari and Pynnönen (2010) to evaluate the significance of the abnormal returns of the event window.

5.2.7 Possible problems with event studies

Event studies are dependent on the ability to measure the size of the surprise. Chosen events should not be anticipated ones to receive statistically significant results from them. As stock markets are always anticipating and speculating upcoming events (especially macroeconomic news), arguably some of the latter events can be rather anticipated ones than pure surprises. Furthermore, as transparency is one of the key factors for central banks, they often endeavor to avoid surprising the markets and as such, the challenge to event studies is even greater. However, the abnormal market conditions after the financial crisis have forced central banks to make quick policy decisions that have not been fully anticipated by the market. To continue with, as the subject (e.g., size, time span and targeted assets) of ECB's purchase programmes varies a lot, even the functioning markets often fail to forecast the exact announcement. In this sense, the possibility of surprise arises. In comparison, the market is able to anticipate changes in interest rates rather well, and thus, the conventional interest rate policy does not usually come as a surprise.

Another challenge for event studies involves the measuring period: How to carefully choose appropriate estimation window and event window. To overcome these challenges, a relatively short estimation period is chosen to avoid overlapping macroeconomic news that might bias the results. For asset purchase programmes, the

event days are the dates, when the purchase programmes have been initially announced to the public (so-called first announcements). The importance of choice of event dates is obvious and has been recognized widely in event studies (see for example Gagnon et al., 2011; Krishnamurthy & Vissing-Jorgensen, 2011).

6 RESULTS

Table 3 presents the average abnormal returns (AARs) and the cumulative average abnormal returns (CAARs) around the short-term event window of [-1,1]. Moreover, the relative adjusted BMP-test statistics are also presented in Table 3. As the results shown in Table 3 are averages, they cover all of the ECB purchase programme announcements that have occurred within the reference period (see Table 2).

Table 3. Average abnormal returns around short-term event window.

STOXX Europe 600			S&P 500		
Event days	AAR	Adjusted BMP	Event days	AAR	Adjusted BMP
-1	0.18%	-0.011	-1	0.63%	0.230
0	0.56%	1.189	0	-0.10%	0.855
+1	0.69%	0.973	+1	0.81%	2.295**
	CAAR			CAAR	
-1 ; +1	1.43%	3.335***	-1 ; +1	1.34%	2.275**

-1 ; +1 = Cumulative Average Abnormal Return (CAAR) of 3-day event window
*** = Statistically significant at the 1% level
** = Statistically significant at the 5% level
* = Statistically significant at the 10% level

Excluding the event day 0 for S&P 500, AARs for individual event days yield positive abnormal returns. As the stock markets in the euro area close earlier than the ones in the U.S., S&P 500 has more time to react to ECB's purchase programme announcements than STOXX Europe 600 on event day 0 (the actual day of the announcement). From the results in Table 2, we can interpret that as the AAR of event day 0 for S&P 500 is -0.10%, the U.S. stock market tracks the intraday effect of ECB's purchase programme announcement on the domestic stock markets of the euro area. Because S&P 500 has more time to digest the ECB's announcement, the intraday stock market reaction of event day 0 is practically non-existent and statistically insignificant. However, the AAR of S&P 500 on event day 1 is 0.81% and statistically significant at 5% significance level. Again, it seems that S&P 500 monitors the euro market and

confirms that the ECB's purchase programme announcement was good news for the market. When viewing AARs as a whole, we see that the stock market requires a little time to process the new information provided by the ECB as no instant intraday abnormal return that would be statistically significant is observed.

The CAAR of the three-day event window cumulates to 1.43% for STOXX Europe 600 and to 1.34% for S&P 500. Furthermore, the adjusted BMP-test shows that CAARs are statistically significant. The CAAR for STOXX Europe 600 is statistically significant at 1% confidence level (Adjusted BMP-test value 3.335), and the CAAR for S&P 500 is statistically significant at 5% confidence level (Adjusted BMP-test value 2.275). What is more, these already strong results are strengthened further with the fact that when an event study has relatively few events of interests (nine in this case), also the lower confidence level, the 10% level, is often accepted. As such, we reject the null hypothesis and accept the alternate hypothesis H1: abnormal returns around events $\neq 0$. The announcement effect of ECB's purchase programmes is distinguishable on [-1,1] event window and yields positive abnormal returns for both STOXX Europe 600 and S&P 500.

Based on these results, we can answer to the research questions 2) to 5):

2) ECB's asset purchase programme announcements have statistically significant announcement effect on STOXX Europe 600 and S&P 500.

3) The announcement effect creates positive short-term abnormal returns.

4) Both the European and the U.S. stock markets respond to ECB's unconventional monetary policy announcements in a similar way on an index level.

5) Even though the results do not indicate significant and instant intraday announcement effect, we can accept the semi-strong form of market efficiency as the cumulative abnormal return pattern on [-1,1] event window is so evident and statistically significant. Furthermore, the international integration and co-movement between the European and the U.S. stock markets exists as the chosen indices, STOXX Europe 600 and S&P 500, yield similar results.

7 CONCLUSION

In Europe and the United States, the critical turning point for monetary policy was the global financial crisis of 2008. Disruptions in the financial markets, notably in the banking sector, and the subsequent sovereign debt crisis in Europe sank global economies into deep recession, well beyond what could be managed by conventional monetary policies. After the ECB and Fed cut short-term interest rates to zero (or nearly so) these central banks turned to unconventional monetary policy tools, especially to balance sheet policies, in order to provide stimulus to the distressed markets.

Motivated by the current popularity of monetary easing through balance sheet policies, this thesis aims to examine, whether the ECB's asset purchase programme announcements lead to a short-term stock market reaction or not. A number of researchers have shown how monetary policy announcements have a significant impact on stock market returns, however, these studies have been mainly local meaning they have focused on the announcement effect between a central bank and its domestic markets. This paper aims to fill that gap by comparing the supposed announcement effect between the domestic index STOXX Europe 600 and the foreign index S&P 500. Furthermore, previous studies often focus on a specific series of purchase programme announcements whereas this study takes all of the ECB's asset purchase programmes (and one relaunch) that have been introduced since the financial crisis into account. By doing so, we can form a timeline which carries more than a decade and on which the events of interest are scattered quite evenly (see Table 2).

Results of this thesis do not show the long-term effects of monetary policy announcements to the stock markets as event studies, by their nature, capture market reactions over only a short time-period. However, throughout this thesis, it is shown how loose monetary policy (low interest rates and liquidity injections through asset purchases) allocates money through monetary transmission mechanism to stock markets and to other asset classes. Moreover, the positive correlation between central banks' balance sheets and stock market development is shown through monetary transmission mechanism and discussion.

Furthermore, the announcement effect of ECB's asset purchase programmes is proved with the event study approach. Announcements of asset purchase programmes yield positive abnormal returns for STOXX Europe 600 and S&P 500. Cumulative abnormal returns around the three-day event window are clear and significant. However, no intraday effect is detected. Efficient market hypothesis and internal integration and co-movement of stock markets are in line with the results and thus provide a theoretical basis for the findings of this thesis.

To sum the monetary policy direction, Constâncio (2017) asks rightly whether the balance sheet measures adopted by major central banks during the financial crisis should remain as permanent parts of the central bank toolkit and continues by stating that the need for these new measures stem from structural changes that have occurred in financial markets. Recently, balance sheet policies were adapted to an unprecedented extent in order to respond to the economic shock from Covid-19 pandemic (see Figure 3 and compare the year-end size of balance sheets between 2019 and 2020). Furthermore, the recessionary supply shock from Covid-19 pandemic was exogenic and derived from imposed restrictions and the sudden economic stagnation that followed it, but in terms of monetary policy, it was treated with the same medicine than the financial crisis, which was endogenic shock.

Finally, to answer the research question 1) It seems that we are witnessing a paradigmatic change in central banking when the toolkit once described as unconventional is now the primary toolkit for central banks to guide the economy. As long as central banks continue stimulative monetary policy by keeping the asset purchase programmes rolling in a low interest rate environment and the transmission channels of monetary policy remain strong, in the absence of alternatives, we can expect the high valuation of stock markets to continue.

Recommendations for future research include the evaluation of unconventional monetary policy tools under normal market conditions, not distressed times. What long-term effects the central banks' Covid-19 monetary easing through balance sheet policies creates on the global economy? Unlike the recovery from the financial crisis, the Covid-19 recovery seems like a V-shaped recovery at least in terms of stock prices (see Figure 5 and Figure 6). Furthermore, as the amount of money in the economy has

risen to record heights, while the inflation targets do not appear to be achievable at all, it is reasonable to question, whether the current situation is stable or not? What is certain, however, is that it is a burning topic under debate.

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APPENDICES

Appendix 1. List of ECB Refinancing Rate changes.

Changes in ECB Refinancing Rate 01/2008 - 12/2020				
n	Date	Type	Magnitude (percentage points)	ECB Refinancing Rate after the change
1.	2008-07-03	Rate increase	+0.25	4.25
2.	2008-10-08	Rate decrease	-0.50	3.75
3.	2008-11-06	Rate decrease	-0.50	3.25
4.	2008-12-04	Rate decrease	-0.75	2.50
5.	2009-01-15	Rate decrease	-0.50	2.00
6.	2009-03-05	Rate decrease	-0.50	1.50
7.	2009-04-02	Rate decrease	-0.25	1.25
8.	2009-05-07	Rate decrease	-0.25	1.00
9.	2011-04-07	Rate increase	+0.25	1.25
10.	2011-07-07	Rate increase	+0.25	1.50
11.	2011-11-03	Rate decrease	-0.25	1.25
12.	2011-12-08	Rate decrease	-0.25	1.00
13.	2012-07-05	Rate decrease	-0.25	0.75
14.	2013-05-02	Rate decrease	-0.25	0.50
15.	2013-11-07	Rate decrease	-0.25	0.25
16.	2014-06-05	Rate decrease	-0.10	0.15
17.	2014-09-04	Rate decrease	-0.10	0.05
18.	2016-03-16	Rate decrease	-0.05	0.00

Appendix 2. List of Federal Funds Target Rate changes.

Changes in Federal Funds Target Rate 01/2008 - 12/2020				
n	Date	Type	Magnitude (percentage points)	Fed Funds Target Rate after the change
1.	2008-01-22	Rate decrease	-0.75	3.50
2.	2008-01-30	Rate decrease	-0.50	3.00
3.	2008-03-18	Rate decrease	-0.75	2.25
4.	2008-04-30	Rate decrease	-0.25	2.00
5.	2008-10-08	Rate decrease	-0.50	1.50
6.	2008-10-29	Rate decrease	-0.50	1.00
7.	2008-12-16	Rate decrease	-0.75	0.25
8.	2015-12-16	Rate increase	+0.25	0.50
9.	2016-12-14	Rate increase	+0.25	0.75
10.	2017-03-15	Rate increase	+0.25	1.00
11.	2017-06-14	Rate increase	+0.25	1.25
12.	2017-12-13	Rate increase	+0.25	1.50
13.	2018-03-21	Rate increase	+0.25	1.75
14.	2018-06-13	Rate increase	+0.25	2.00
15.	2018-09-26	Rate increase	+0.25	2.25
16.	2018-12-19	Rate increase	+0.25	2.50
17.	2019-07-31	Rate decrease	-0.25	2.25
18.	2019-09-18	Rate decrease	-0.25	2.00
19.	2019-10-30	Rate decrease	-0.25	1.75
20.	2020-03-04	Rate decrease	-0.50	1.25
21.	2020-03-18	Rate decrease	-1.00	0.25